

# Rapid Response Team

**Mike Syphers**

**DOE/Lehman Review**

**February 24-26, 2004**

# Response Team Mission

- Used to solve pressing operational or accelerator physics problems
  - o Tasks expected to have few week to few month life spans
  - o Focus is on one or two problems at a time (i.e. Injection matching into the TEV, Bunch length in the Main Injector, NUMI commissioning)
  - o Membership will be dynamic
  - o Assignments of Rapid Response Team negotiated through the Coordination Team

# Response Team Organization

- Members --
  - Mike Syphers, Leader
  - John Johnstone
  - Others as needed, according to current studies
- Energy Deposition Group --
  - Nikolai Mokhov, Leader
  - Sasha Drozhzin
  - Mikail Kostin
  - Sergei Striganov (guest scientist)
  - Ludovic Nicolas (guest scientist, student)

# Recent Activities

- Previous to re-organization...
  - Team concept was somewhat in place, as twice-weekly discussions were held to understand Tevatron optics, beam lifetime, correction systems issues
  - Led to magnet realignment and understanding of large coupling in Tevatron
- Since re-organization...
  - CDF / B0 realignment (December 2003)
  - Switchyard 120 -- Slow Spill (Jan-Feb 2004)
  - Booster collimator system commissioning

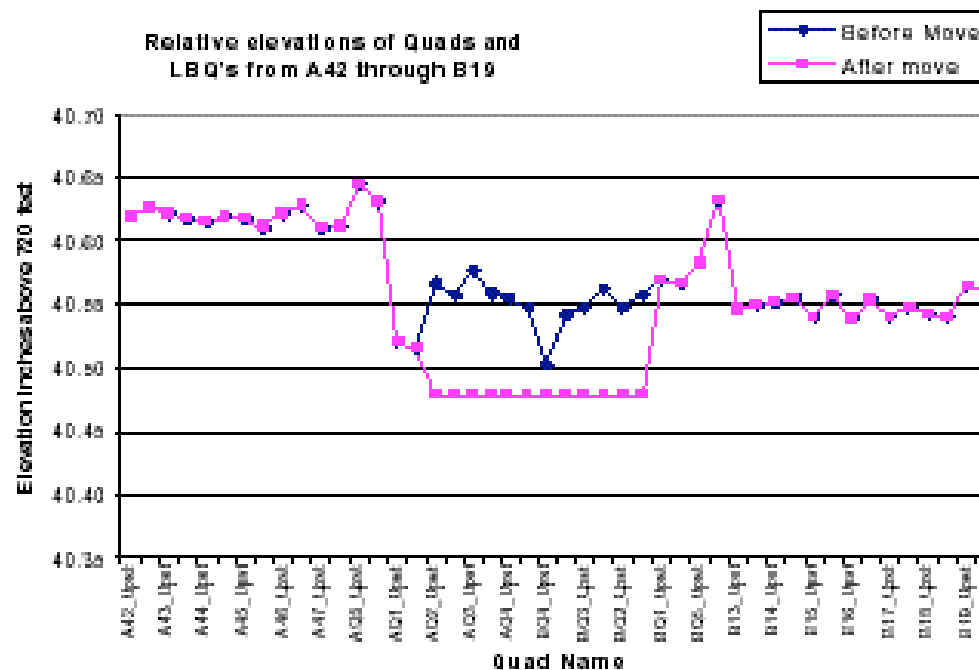
# CDF / B0 Alignment Effort

- **The Issue --**

- CDF detector has been moving vertically relative to the Tevatron orbit; was sitting about 4 mm below its desired level, and a 200  $\mu$ rad angle across the detector had developed.
- Due to this, the CDF detector was experiencing about 25% inefficiency in tagging B-mesons with the Silicon Vertex Detector.
- Meanwhile, magnet surveys showed that the IR triplet magnets were out of alignment, plus several Tevatron vertical steering magnets were running near their operational limits.
- Decision was made to attempt to straighten out triplet magnets and to steer the Tevatron beam down and through the center of the quads, reducing corrector strengths where possible.

# CDF / B0 Alignment Effort

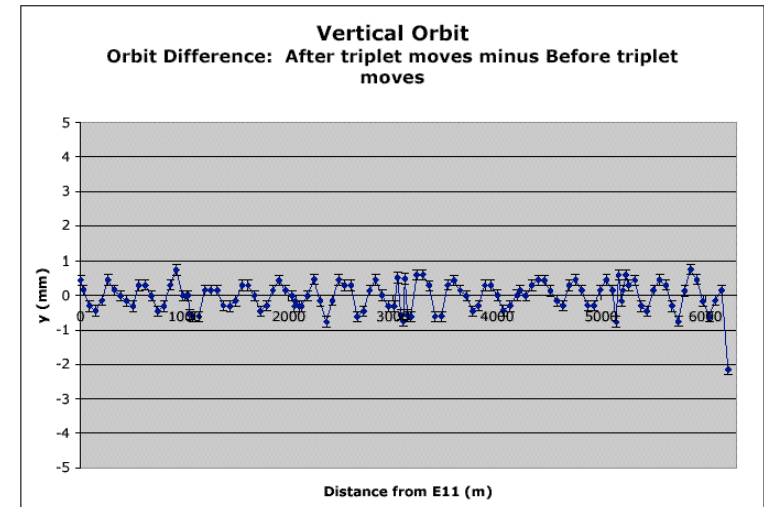
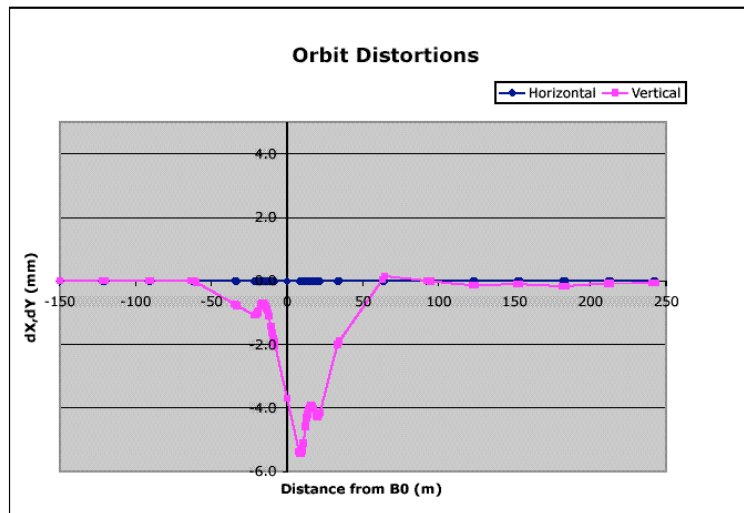
- **People involved:**
  - M. Syphers, J. Annala, N. Gelfand, V. Lebedev, plus J. Volk, V. Shiltsev, others, plus CDF



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# CDF / B0 Alignment Effort

**Expected closed orbit distortion:**



**Dead-reckoned correctors after magnet moves;  
resulting residual orbit outside of Interaction  
Region ~0.5 mm amplitude (easily corrected)**

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# Switchyard 120 Effort

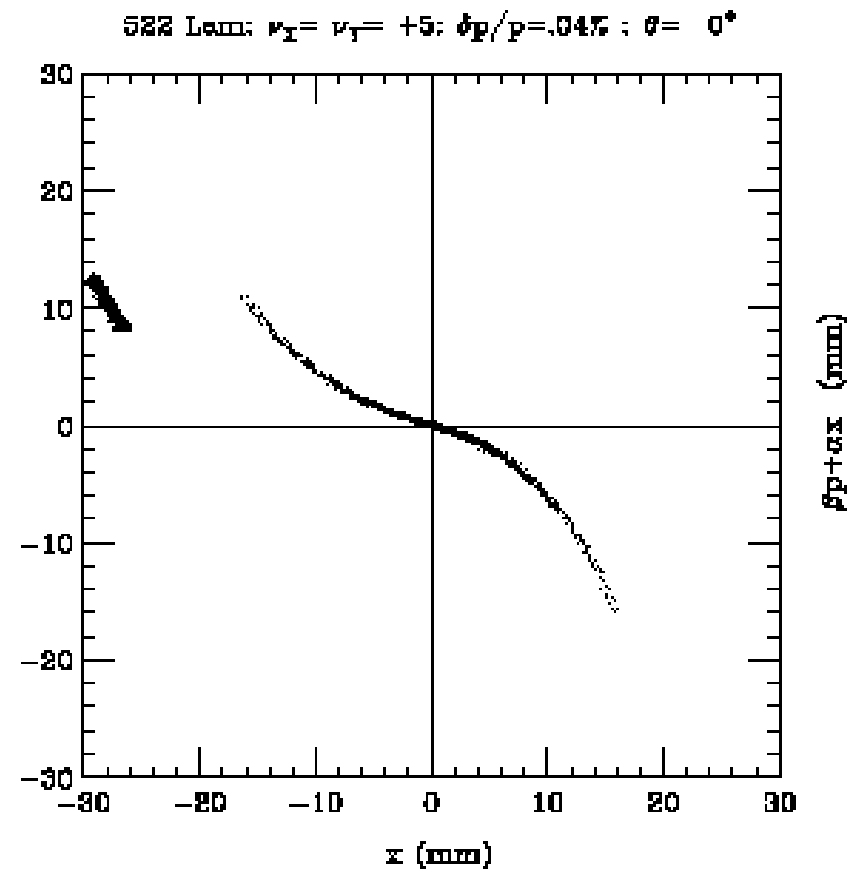
- **The Issue:**
  - **Slow Spill (resonant extraction) was established from the Main Injector in 2000 (demonstration). Is to be used for Switchyard 120 project -- test beams, experiments in Meson area using primary proton beams at 120 GeV**
  - **SY120 project installation completed recently; however, trouble establishing slow spill again; after several weeks (months) of part-time effort, no slow spill**
- **Required Assembly of a different group**
  - **M. Syphers, D. Johnson, J. Johnstone, M-J Yang, A. Marcionni, with C. Brown, S. Childress, others**
- **Major contribution was the organization of effort (involving Main Injector and External Beams Departments) into more coherent goals and procedures**

# Switchyard 120 Effort

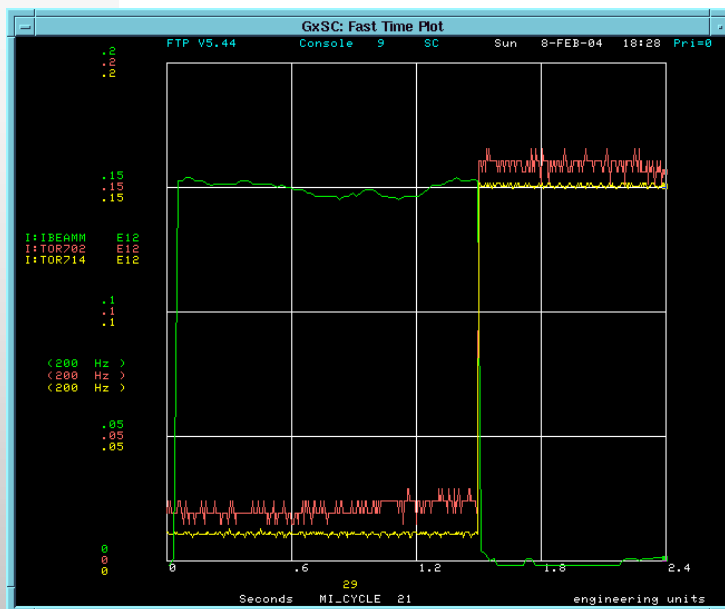
- **Required**
  - Understanding of Main Injector properties -- orbits, tunes, etc. -- under half-integer resonance conditions
  - Commissioning of proper instrumentation
  - Making the electrostatic septa the defining horizontal aperture
  - Minimizing effects of ES on 8 GeV beam on all beam cycles
  - Establishing proper phase space orientation to minimize losses around the ring (e.g., at NuMI extraction Lambertsons, etc.)
  - Lots of fine tuning...
- **After ~7 days, beam was being extracted (~20% efficient).**
- **After ~15 days, ~100% efficient.**
  - **Note: required intensities are low for the slow spill program**  
**Fast spill (single-turn extraction) down the beam line had been established for some time; also at low intensities**

# Switchyard 120 Effort

- Phase space manipulation, using harmonic quadrupoles (J. Johnstone).
- Needed to adjust phase space to “squeeze” through tight aperture restrictions (NuMI Lambertsons, for example).

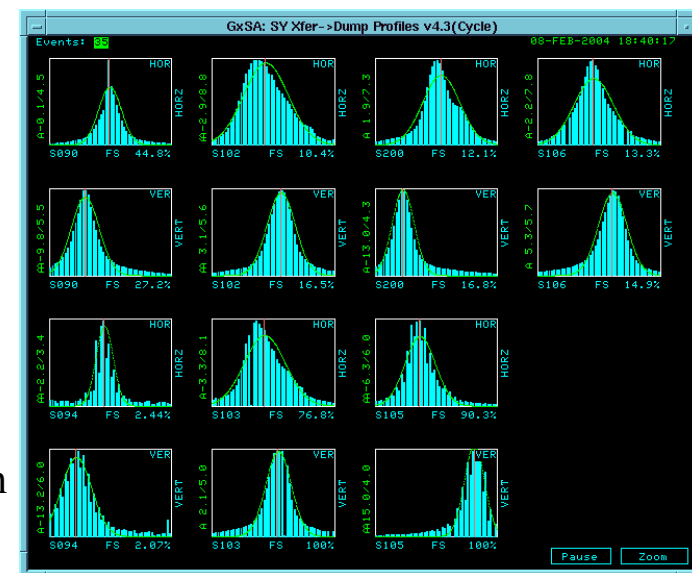


# Switchyard 120 Effort



Green curve: MI beam current (torroid)  
Red curve: Extracted beam current  
(resonant BPM)

Beam profile measurements through  
Switchyard to the SY beam dump...



# Energy Deposition Efforts

- **Important to keep this world-renowned group together**
- **Efforts continue on many fronts for Run II, including**
  - Booster shielding and modeling
  - Tevatron and detector shielding calculations
  - NuMI calculations
  - etc.
- **Plus keeping up with other work outside Run II**
  - LHC, LC, Proton Driver studies, etc.
- **A rapid response:**
  - 16-house quench

# 16-House Quench Examination

Damage to D49 estimated to take about 20-30 turns to create hole.  
Once the hole was open, allowed beam to travel to next limiting horizontal aperture which is E03

MARS simulation results:

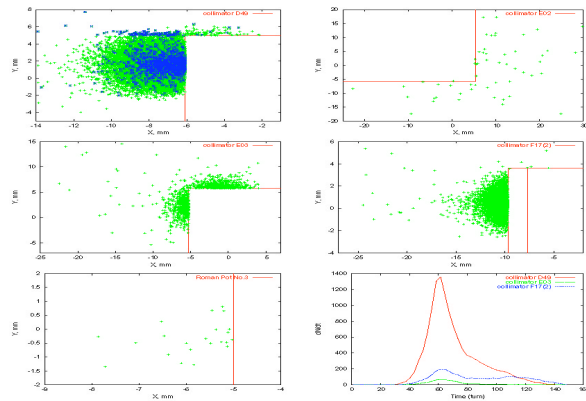
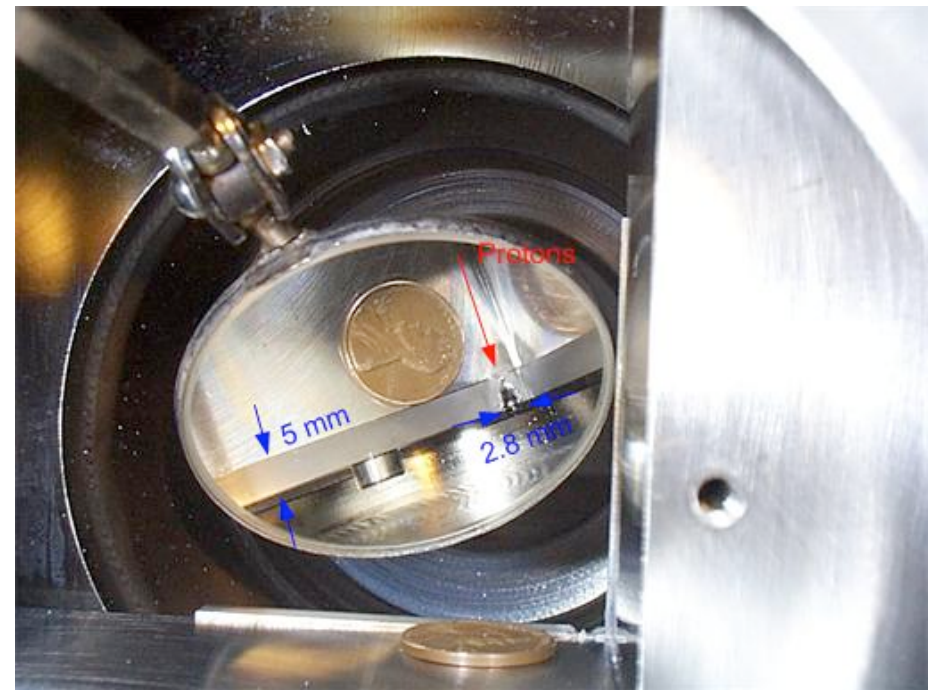


Figure 14: Particle hits at the collimators D49, E02, E03, F172 and at Roman Pot No.3 at dynamic simulations of quench of 5 main dipoles at A48 region. Time histogram of hits is shown on bottom-right of figure. Field degradation rate is  $dB/B = 2.386 \times 10^{-5}$ . Horizontal collimator F17(2) is retracted from working positions by 3 mm back, all others are retracted by 1 mm. The collimator D49 is assumed is melting with a rate of 0.04 mm per turn.

(Courtesy A. Drozhzin)

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(Photo courtesy D. Still)

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# Investigations coming up?

- **Possible topics of interest include:**
  - **Booster collimator system commissioning**
  - **Examination of Tevatron correction circuits**
  - **Measurement/control of  $\beta^*$  at IP**
  - **Tevatron DC beam generation**
  - **Orbit drifting in the Tevatron**
  - **Emittance preservation throughout accelerator chain**
  - **Beam transfers between accelerators:**
    - **Frequency (circumference) matching**
    - **Optical function matching**
  - **C0 IR optics (J. Johnstone to continue)**
  - **???**
- **Will be “responding” to the important issues as they arise...**